

Interplanetary Medium and Geophysical Phenomena During Geomagnetic Storms

Geomagnetic storms and space weather is a complex topic where the overall picture is put together from pieces derived from intense research by individual scientists at home institutions and by lively discussions of these results at scientific meetings. A two-day symposium GA 4.08 "Interplanetary Medium and Geophysical Phenomena During Geomagnetic Storms" has been held at the 22nd General Assembly of the International Union of Geodesy and Geophysics (Birmingham, England, July 28-29, 1999), allowing scientists from all over the world to present their new and latest results. This special issue of the Journal of Atmospheric and Solar-Terrestrial Physics (JASTP) is a direct result of this symposium, providing a means for other scientists working on the topic of space weather to keep current with their colleagues.

Over the last decade we have learned a great deal about space environment in which the Earth is immersed. Magnetic reconnection is the most likely mechanism for causing solar flares and the formation and release of coronal mass ejection (CMEs). We know that the energetic particles, which are a hazard to interplanetary and Earth-orbiting spacecraft and man in space, come in three flavors. There are the "prompt" particles that are accelerated at the flare site by various processes currently being debated, as well as particles that are accelerated at interplanetary shocks located upstream of fast interplanetary CMEs (ICMEs), and energetic magnetospheric particles that are accelerated by a number of different processes associated with magnetic storms caused by the ICME interaction with the Earth's magnetosphere. To confuse matters, there is shock acceleration of energetic particles during the declining/solar minimum phases of the solar cycle at the edges of corotating interaction regions (forward and reverse shocks). All of these particle sources are distinct and different.

ICMEs (only parts of CMEs may get into interplanetary space and they may also evolve as they propagate through space and thus are called ICMEs for obvious reasons) have been found to not only not always cause intense storms at Earth, but they have been noted to cause intense quiet as well. Again, magnetic reconnection (or lack thereof) has been found to be the key energy transfer process. The ICME and/or upstream sheath magnetic fields must be intense, southwardly directed, and have duration of hours in order to cause intense storms. If any of these three features are not met, the storm will not be particularly intense. The definition of storm "intensity" and the mechanism for particularly large D_{st} index values has recently come into question. Do

double (or triple) IMF Bs events lead to compound ring-currents and large Dst values? What are the interplanetary mechanisms for such events?

The following papers represent some further advances of various facets in our understanding of the magnetic storms and space weather problem. The first six papers included in this special issue are invited talks presented at the symposium by renowned scientists. These papers cover a sequence of topics starting from solar sources of CMEs, advancing through reviews of interplanetary and magnetospheric sources of magnetic storms, and ending with analysis of the magnetosphere-ionosphere coupling, ionospheric response, and geomagnetic field modeling during magnetic storms. A number of contributed talks (but not all presented) included in this issue range from theoretical analyses of various storm-related mechanisms to experimental observations in the magnetosphere and on the Earth's surface. CME release mechanisms/conditions, interplanetary causes and evolution of these features plus shock affects on the magnetosphere are reviewed. The energetic particle dynamics within the magnetosphere, related electric fields and ionospheric responses are also summarized. New results on the ionosphere and atmospheric storm-time dynamics, geotail and ring current evolution, plus magnetic topology and variations are of particular interest.

We thank Tim Killeen, Editor-in-Chief, for providing this exciting opportunity to publish in JASTP the results of the symposium we convened, and we note that all papers in the issue were evaluated individually according to the rigorous standards established by the journal. We hope that the reader will find this collection of papers interesting and useful for future references.

Guest Editors: B. T. Tsurutani, V. O. Papitashvili, J. Lastovicka, and Ya. I. Feldstein